Chunghwa Picture Tubes, Ltd.
Technical Specification

To : **BenQ**
Date : 2007/04/18

CPT TFT-LCD
CLAA 220WA09

ACCEPTED BY：

APPROVED BY	CHECKED BY	PREPARED BY
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1. OVERVIEW

CLAA220WA09 is 21.6" color TFT-LCD (Thin Film Transistor Liquid Crystal Display) module composed of LCD panel, driver ICs, control circuit and backlight. By applying 6 bit digital data, 1680×1050, 16.7M-color images are displayed on the 21.6" diagonal screen. Input power voltage is 5.0V for LCD driving. Inverter for backlight is not included in this module. General specification is summarized in the following table:

ITEM	SPECIFICATION
Display Area(mm)	464.94 (H) × 290.5875 (V)
Number of Pixels	1680 (H) × 1050(V)
Pixel Pitch(mm)	0.27675(H) × 0.27675(V)
Color Pixel Arrangement	RGB vertical stripe
Display Mode	Normally white, TN
Number of Colors	16.7M(6bits+Hi-FRC)
Brightness(cd/m^2)	300cd/m^2 (Typ.)(center, 7.0mA)
Viewing Angle(H/V)	160/160 (Typ.)
Surface Treatment	Anti-glare, 3H
Power consumption(W)	(31.5) (Typ.) (w/o Inverter)
Module Size(mm)	493.7 (W) × 320.1 (H) ×16.5 (D) (Typ.)
Module Weight(g)	3000(Typ.)
Backlight Unit	CCFL, 4 tubes(top × 2/bottom × 2) , Edge light

2. ABSOLUTE MAXIMUM RATINGS

ITEM	SYMBOL	MIN.	MAX.	UNIT	REMARK
Power Supply Voltage for LCD	VCC	0	6	V	
Lamp Voltage	VL	(TBD)	(TBD)	Vrms	
Lamp Current	ILO	3	8	mArms	
Lamp Frequency	FL	40	60	kHz	
static electricity	VESDt	-200	200	V	*5)
	VESDc	-8000	8000	V	
Operation Temperature	Top	0	50	℃	*1). 2). 3). 6)
Storage Temperature	Tstg	-20	60	℃	*1). 2). 3)
Delayed Discharge Time	TD	--	1	sec	*8)

[Note]

1). The relative temperature and humidity range are as below sketch, 90%RHMax.(Ta≦40℃).

2). The maximum wet bulb temperature ≦39℃(Ta＞40℃) and without dewing.

3). If you use the product in a environment which over the definition of temperature and humidity too long to effect the result of eye-etching.

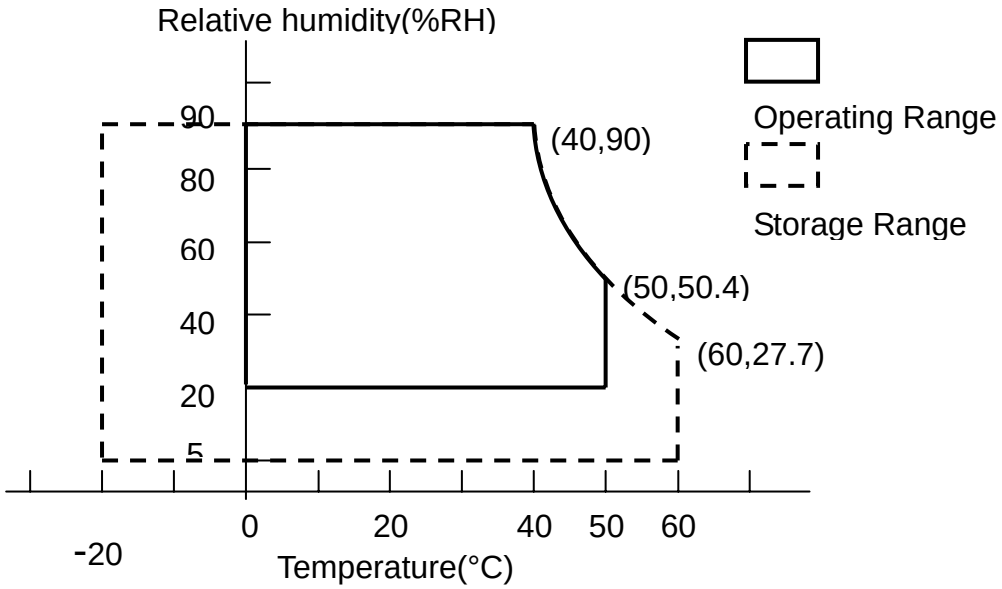
4). The life time of the lamp is related to the current of the lamp, so please according to the description of the "(b) backlight" on page 7.

5). Test Condition: IEC 1000-4-2 VESDt: Contact discharge to input connector; $VESD_C$: Contact discharge to module

6). If you operate the product in normal temperature range, the center surface of panel should be under 60℃.

7). When lamp current is out of the absolute maximum range, the life will fall rapidly or shown unusual sign.
IL min **2**mA only for test only, but we can't guarantee the lifetime and performance.

8). Delay lighting testing needs the volt above start voltage Vrms**.** Before the procedure tube needs typical lighting for 1 minute and stay in the temperature 25±2℃ for 24 hours and then testing in the same condition in dark room**.**



3. ELECTRICAL CHARACTERISTICS

(1).TFT-LCD Ta=25℃

ITEM		SYMBOL	MIN	TYP	MAX	UNIT	REMARK
Power Supply Voltage for LCD		VCC	4.5	5.0	5.5	V	*1)
Power Supply Current for LCD		ICC	--	900	1500	mA	*2)
Permissive Ripple Voltage for Logic		VRP	--	--	100	mVp-p	VCC=5.0V
Differential Resistance		Zm	90	100	110	Ω	
LVDS: IN+，IN-	The same motion input Voltage	VCM	1.125	1.25	1.375	V	*3)
	Differential input Voltage	| VID |	250	350	450	mV	
	High electric potential threshold voltage	VTH	-	-	100	mV	
	Low electric potential threshold voltage	VTL	-100	-	-	mV	
LCDInrush Current		Inrush	-	-	3	A	*4)
Power consumption		P	-	4.5	7.5	W	*2)

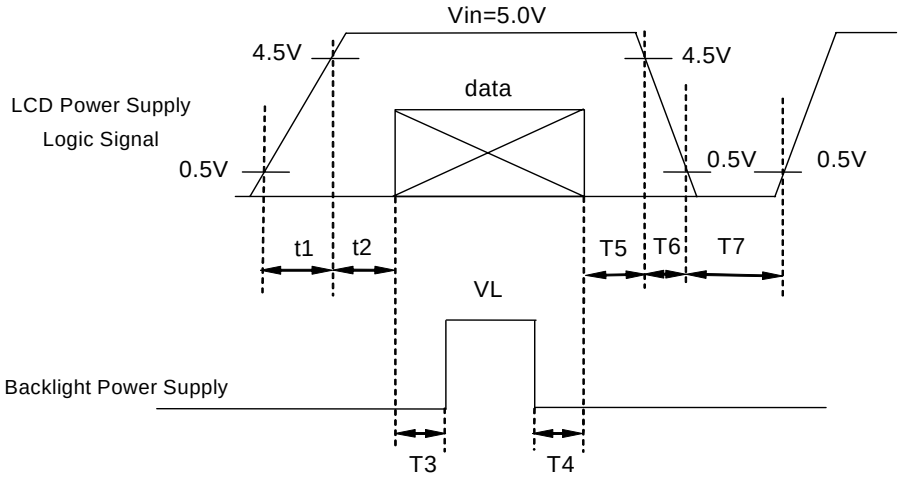
[Note]

*1)Power、data sequence

0.5ms＜t1＜10ms　　t4＞200ms　　t7＞1sec

0＜t2＜50ms　　0＜t5＜50ms

t3＞250ms　　0.01ms＜t6＜10ms

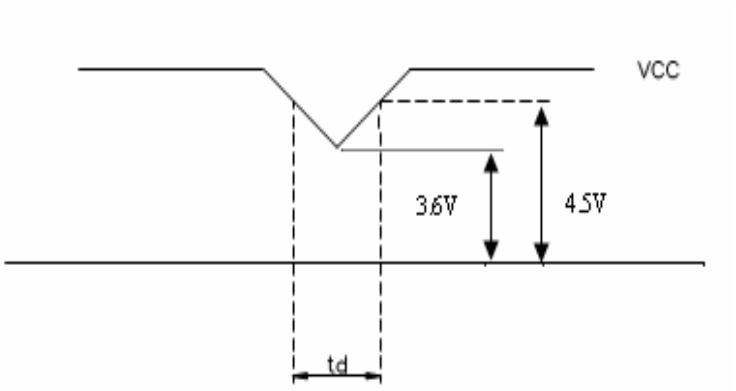


Data: RGB DATA, DCLK, DENA

VCC-dip conditions:

(1) When 3.6V≦Vcc(min)<4.5V: td≦10 ms

(2) When Vcc <3.6 V, VCC-dip conditions should also follow the VCC-turn-on conditions.

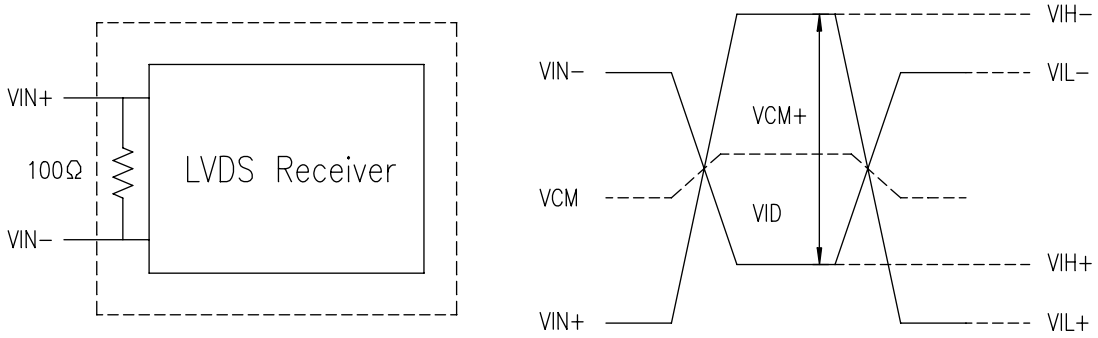


2). Typical value is measured when displaying horizontal gray scale line pattern:

64 gray level, 1680 line mode

VCC=5.0 V，f_H=65 kHz，f_V=60 Hz，f_{CLK}=73.5 MHz

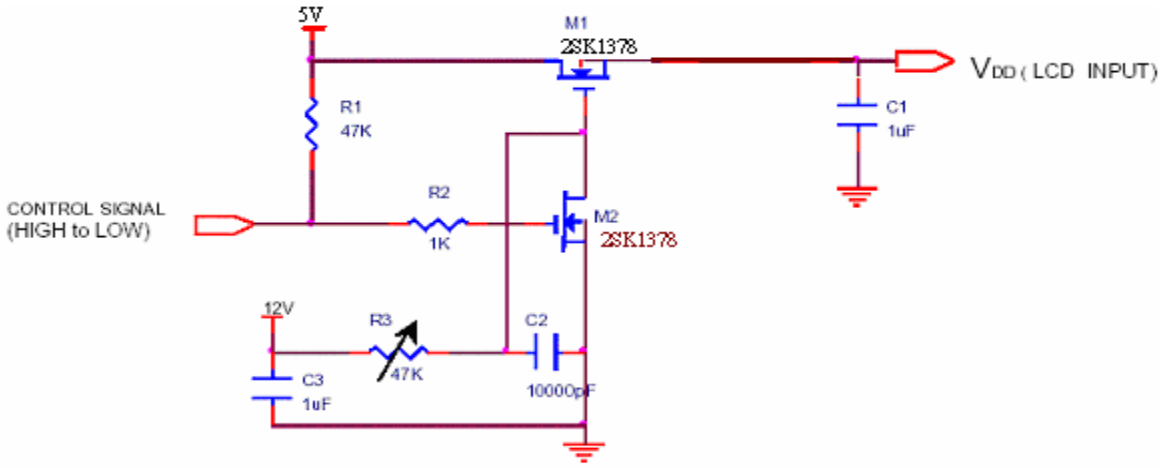
3).LVDS Signal definition:

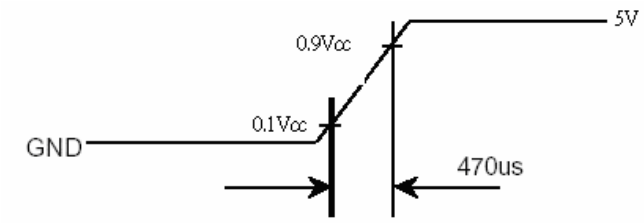


VIN+：Positive differential DATA & CLK Input

VIN-： Negative differential DATA & CLK Input

4).Irush Measurement Condition





(2).Backlight

1. Electrical specification

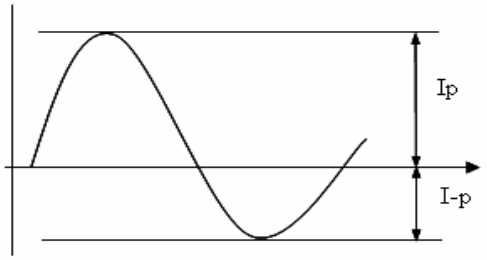
ITEM	SYMBOL	MIN	TYP	MAX	UNIT	REMARK
B/L Voltage	VL	(TBD)	(TBD)	(TBD)	Vrms	IL=7.0mA Ta=25℃
B/L Current	IL	6.5	7.0	7.5	mArms	*1) Ta=25℃
B/L operating current	ILO	3	7.0	8	mArms	*1) Ta=25℃
B/L power consumption	WL	—	(TBD)	(TBD)	W	IL=7.0mA Ta=25℃
Inverter Frequency	FI	40	50	60	kHz	*2) Ta=25℃
Starting Lamp Voltage	VS	—	—	(TBD)	Vrms	Ta=0℃
		—	—	(TBD)	Vrms	Ta=25℃

2. Lamp life time

ITEM	ILO at 3.0 mA	ILO at 7.0 mA	ILO at 8.0 mA	UNIT	REMARK
Life	(TBD)	TYP. 40,000	(TBD)		
Rated time (turn on/off)	—	Min.100,000	—	time	*4)

[Note] Inverter vendor: Sumida, model: IV50167/T

If the waveform of light up-driving is asymmetric, the distribution of mercury inside the lamp tube will become unequally or will deplete the Ar gas in it. Then it may cause the abnormal phenomenon of lighting-up. Therefore, designers have to try their best to fulfill the conditions under the inverter designing-stage as below:

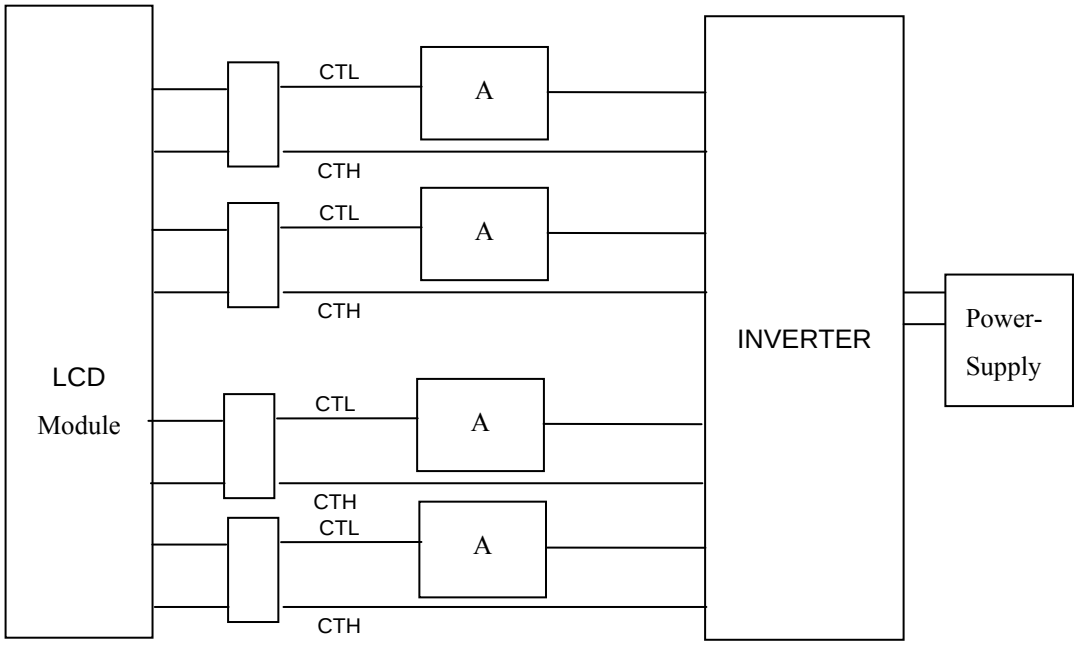


Ip：high side peak

I-p：low side peak

A：The degrees of unbalance = |Ip – I-p |/ Irms ×100 (%)
B：The ratio of wave height = Ip (or I-p) / Irms

1) Lamp Current measurement method (The current meter is inserted in cold line)



2) a. Frequency in this range can make the characteristics of electric and optics maintain in +/- 10% except color coordinates.
   b. Frequency in 50~60kHz can make characteristics of electric and optics better.
   c. Frequency in 45~80kHz won't damage the lifetime and reliability of lamp.
   d. Lamp frequency of inverter may produce interference with horizontal(or vertical) synchronous frequency,and this may cause horizontal beat on the display.Therefore, please adjust lamp frequency, and keep inverter as far from module as possible or use electronic shielding between inverter and module to avoid the interference.

3) Definition of the lamp life time：
   a. Luminance (L) under 50% of specification.
   b. Starting Lamp Voltage: over130% of the initial value. Ta=25℃

4) The condition of Turn-on and Turn-off operation is as below:
   a. Lamp current is 7.0mA
   b. Frequency is 30 sec.(on)/30 sec.(off)
   c. Repeat it for 100 thousand times
   d. The lamp hue variation must smaller than 0.03
   e. It should not have motion fail when starting lamp voltage is lower than 130%of the initial value.

5) For keeping good lighting situation ,when design the inverter ,it must be considered that the voltage large than starting lamp voltage.

6) WL=IL x VL x 4。(IL=7mA，Ta=25℃)

4. INTERFACE PIN CONNECTION

(1) CN1

Outlet connector: FI-XB30SSRL-HF16 (JAE) (or equivalent)

PIN NO.	REMARK	FUNCTION
1	RXO0-	minus signal of odd channel 0(LVDS)
2	RXO0+	plus signal of odd channel 0(LVDS)
3	RXO1-	minus signal of odd channel 1(LVDS)
4	RXO1+	plus signal of odd channel 1(LVDS)
5	RXO2-	minus signal of odd channel 2(LVDS)
6	RXO2+	plus signal of odd channel 2(LVDS)
7	GND	GND
8	RXOC-	minus signal of odd clock channel (LVDS)
9	RXOC+	plus signal of odd clock channel (LVDS)
10	RXO3-	minus signal of odd channel 3(LVDS)
11	RXO3+	plus signal of odd channel 3(LVDS)
12	RXE0-	minus signal of even channel 0(LVDS)
13	RXE0+	plus signal of even channel 0(LVDS)
14	GND	GND
15	RXE1-	minus signal of even channel 1(LVDS)
16	RXE1+	plus signal of even channel 1(LVDS)
17	GND	GND
18	RXE2-	minus signal of even channel 2(LVDS)
19	RXE2+	plus signal of even channel 2(LVDS)
20	RXEC-	minus signal of even clock channel (LVDS)
21	RXEC+	plus signal of even clock channel (LVDS)
22	RXE3-	minus signal of even channel 3(LVDS)
23	RXE3+	plus signal of even channel 3(LVDS)
24	GND	GND
25	NC	NC
26	NC	Test pin (Can't connect to GND)
27	NC	NC
28	VCC	Power supply input voltage(5.0 V)
29	VCC	Power supply input voltage(5.0 V)
30	VCC	Power supply input voltage(5.0 V)

1) Keep the NC Pin and don't connect it to GND or other signals.

2) GND Pin must connect to the ground, don't let it be a vacant pin.

(2) CN2, 3, 4, 5 (BACKLIGHT)

CN2、CN3、CN4、CN5：35001HS-02L (YEONHO)

<Mating connector: 35001WR-02L(YEONHO)>

No.	Pin	Symbol	Description
CN2	1	HV	High Voltage Output for CCFL Lamp 1
	2	LV	Low Voltage Output for CCFL Lamp 1
CN3	1	HV	High Voltage Output for CCFL Lamp 2
	2	LV	Low Voltage Output for CCFL Lamp 2
CN4	1	HV	High Voltage Output for CCFL Lamp 3
	2	LV	Low Voltage Output for CCFL Lamp 3
CN5	1	HV	High Voltage Output for CCFL Lamp 4
	2	LV	Low Voltage Output for CCFL Lamp 4

5. INTERFACE TIMING

(1) Timing Characteristic

ITEM				SYMBOL	MIN.	TYP.	MAX.	UNIT
LCD Timing	DCLK		Freq.	f_{CLK}	61	73.5	83	MHz
			Cycle	t_{CLK}	12	13.6	16.4	ns
	DENA	Horizontal	Horizontal total time	t_H	880	1135	1300	t_{CLK}
			Horizontal effective time	t_{HA}	840	840	840	t_{CLK}
			Horizontal blank time	t_{HB}	40	295	460	t_{CLK}
		Vertical	Vertical frame Rate	Fr	55	60	75	Hz
			Vertical total time	t_V	1060	1080	1300	t_H
			Vertical effective time	t_{VA}	1050	1050	1050	t_H
			Vertical blank time	t_{VB}	10	30	250	t_H

[Note]

*1) DENA (data enable) usually is positive

*2) DCLK still inputs during blanking

*3) LVDS transmitter IC: : NT71671-00033(NVT)

*4) LVDS IC：

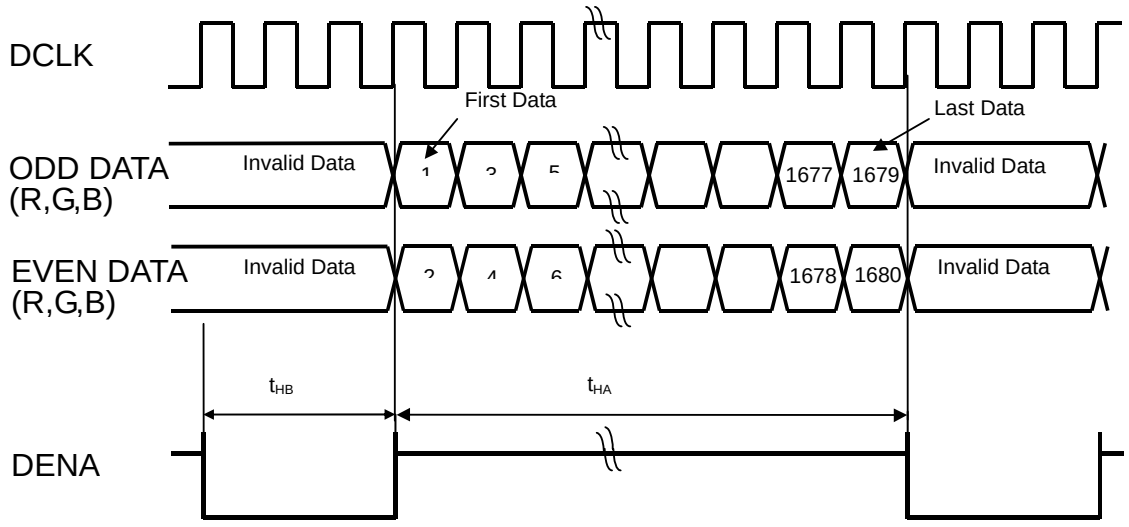
Receiver	Transmitter
DS90C384MTD(NS)	DS90C383MTD(NS)
SN75LVDS82(TI)	SN75LVDS83(TI)

*5) DE mode only

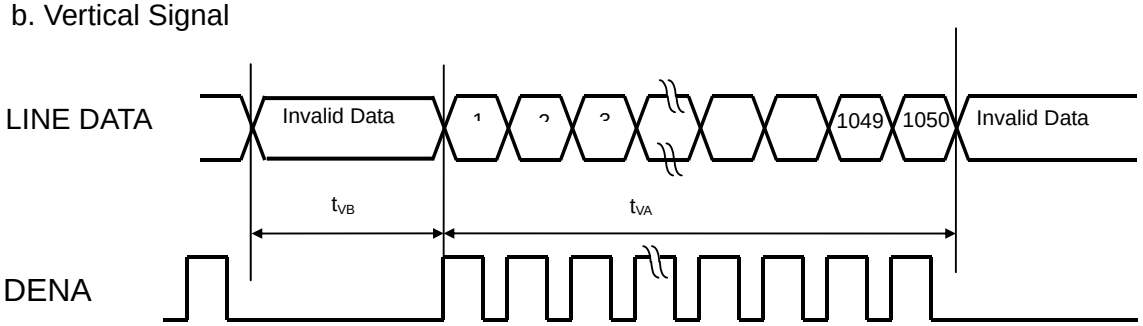
*6) It maybe cause flicker at 55Hz

(2).Timing Chart

a. Horizontal Signal

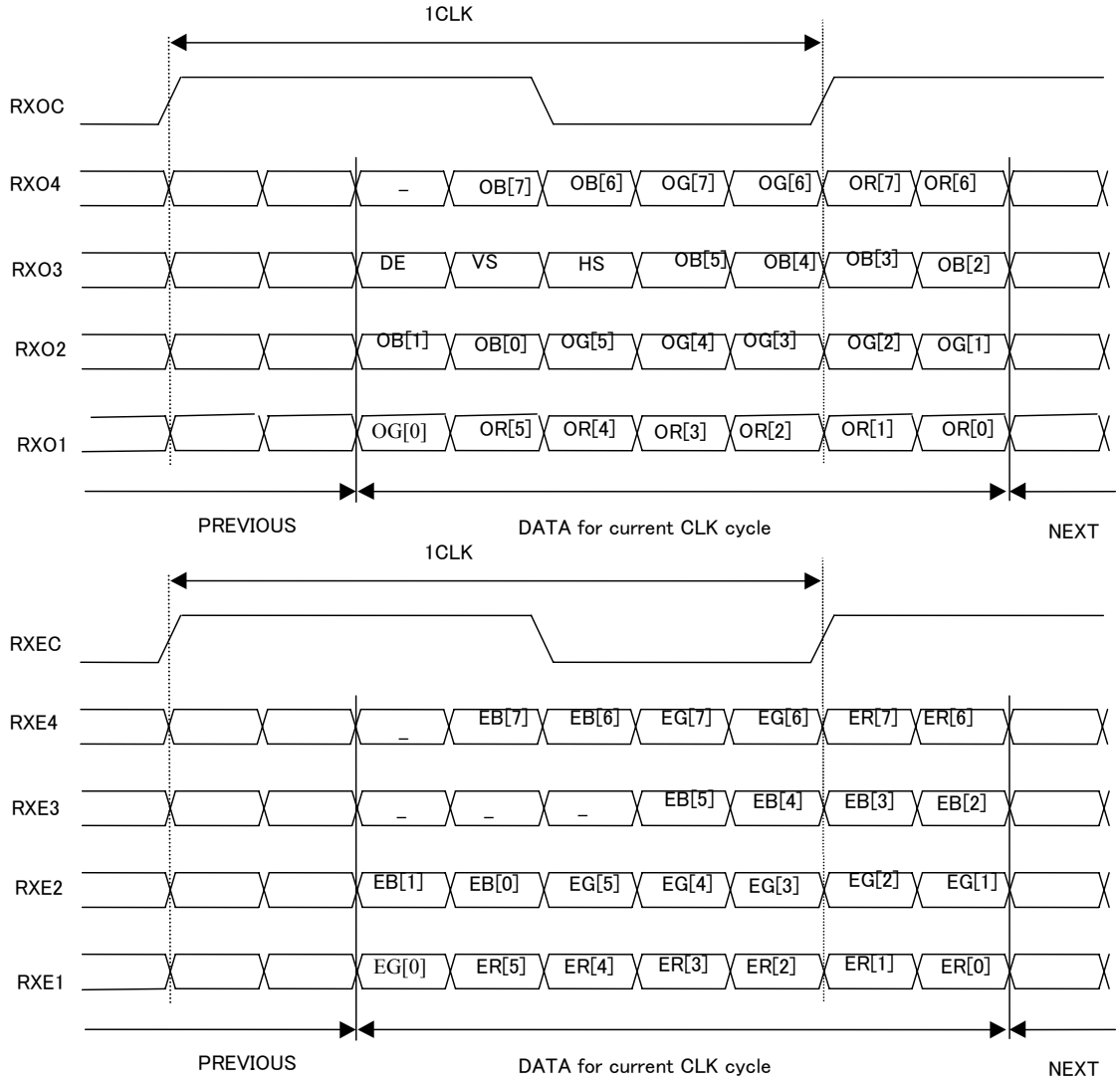


b. Vertical Signal



(3).LVDS Data

For 6Bit+Hi-FRC



Color Data Assignment

COLOR	INPUT DATA	R DATA								G DATA								B DATA							
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
		MSB							LSB	MSB							LSB	MSB							LSB
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN(255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	BLUE(255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	CYAN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	MAGENTA	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	WHITE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
RED	RED(0)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(1)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(2)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(254)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GREEN	GREEN(0)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	GREEN(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	GREEN(254)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	GREEN(255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
BLUE	BLUE(0)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	BLUE(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	BLUE(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	BLUE(254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	BLUE(255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

[Note] 1) Definition of gray scale: Color (n): n indicates gray scale level; higher n means brighter level.

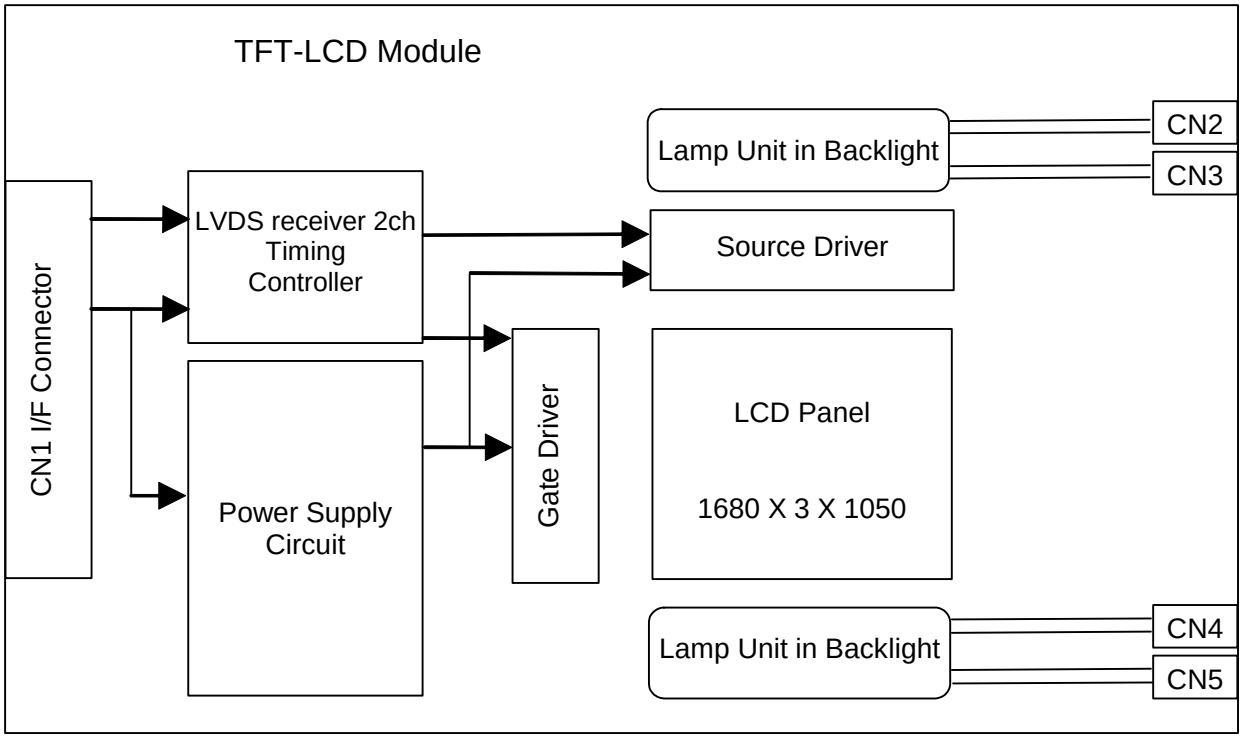
2) Data: 1-High, 0-Low.

3)For odd & even data also.

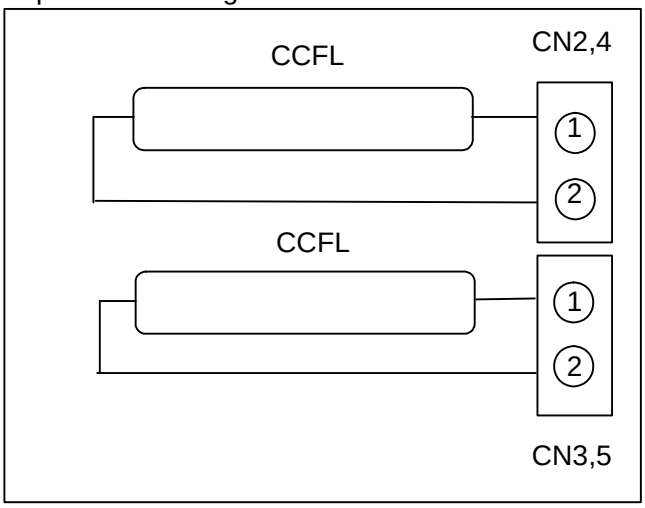
(4).Color Deta Distribution

D(1,1)	D(2,1)	..	D(X,1)	..	D(1679,1)	D(1680,1)
D(1,2)	D(2,2)	..	D(X,2)	..	D(1679,2)	D(1680,2)
..	..	+	..	+	..	..
D(1,Y)	D(2,Y)	..	D(X,Y)	..	D(1679,Y)	D(1680,Y)
..	..	+	..	+	..	..
D(1,1049)	D(2,1049)	..	D(X,1049)	..	D(1679,1049)	D(1680,1049)
D(1,1050)	D(2,1050)	..	D(X,1050)	..	D(1679,1050)	D(1680,1050)

6. BLOCK DIAGRAM

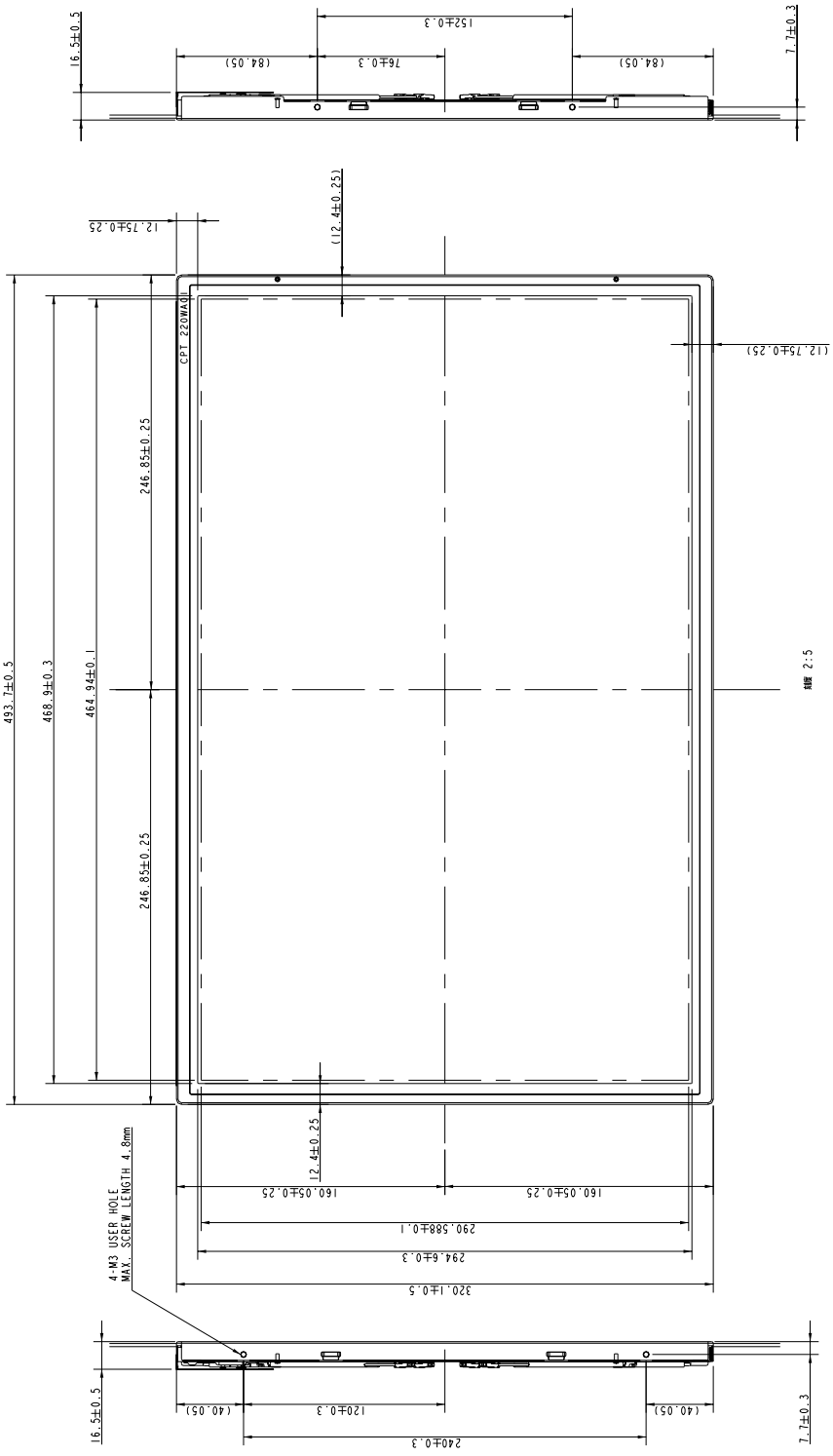


Lamp Uint in Backlight

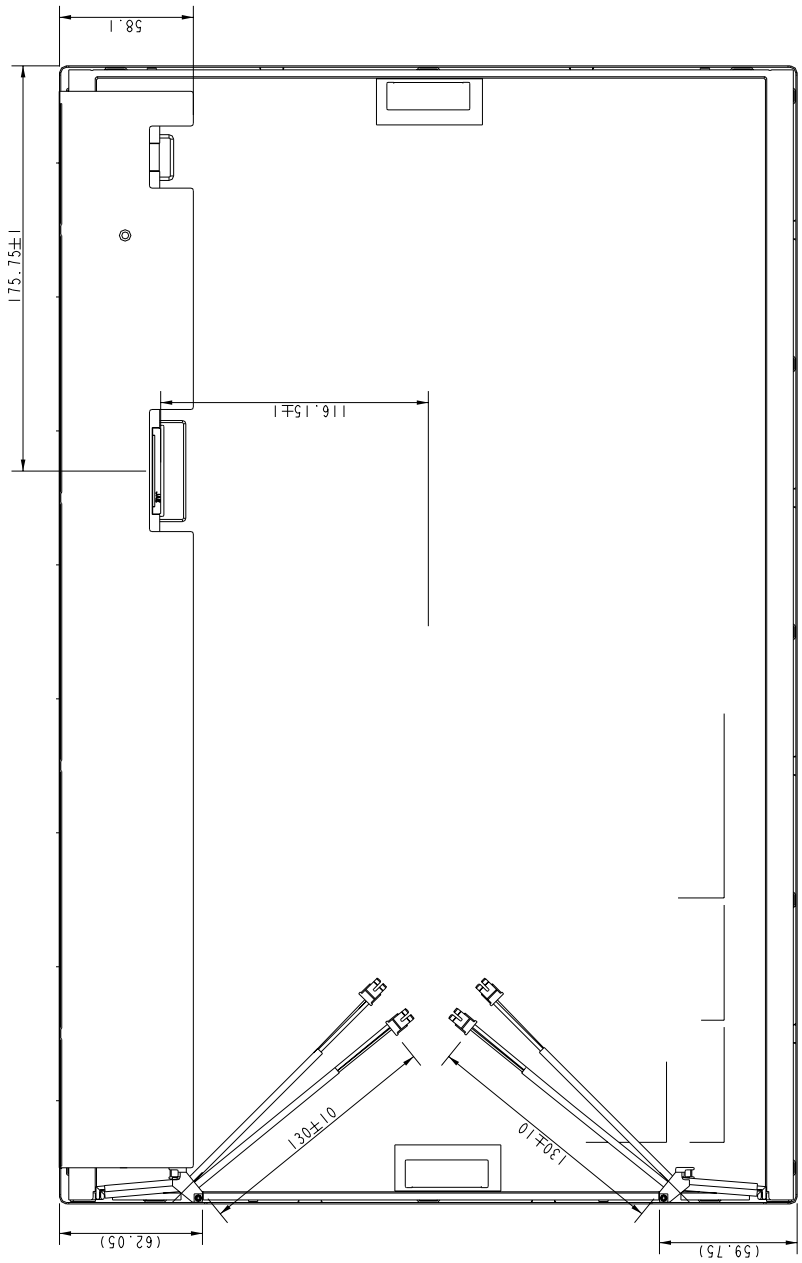


7. MECHANICAL SPECIFICATION

(1) Front side (Tolerance is ± 0.5mm unless noted) [Unit:mm]



(2)Rear side (Tolerance is ±0.5mm unless noted) [Unit: mm]


58.1
175.75±1
116.15±1
61±0.1
130±1.0
(62.05)
(59.75)

8. OPTICAL CHARACTERISTICS

Ta=25℃，VCC=5.0V

ITEM		SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	REMARK
Contrast (CEN)		CR	θ=ψ= 0°	(700)	1000	--	--	*1)
Luminance (CEN)		L	θ=ψ= 0°	250	300	--	cd/m^2	*2)
9P Uniformity		ΔL	θ=ψ= 0°	75	--	--	%	*2)
Response Time		Tr+Tf	θ=ψ= 0°	--	5	10	ms	*4)
Cross talk		CT	θ=ψ= 0°	--	--	1	%	*5)
View angle	Horizontal	ψ	CR≧10	140	160	--	Deg.	*3)
	Vertical	θ		140	160	--	Deg.	
	Horizontal	ψ	CR≧5	150	170	--	Deg.	
	Vertical	θ		150	170	--	Deg.	
Color Coordinates	White	x	θ=ψ= 0°	0.283	0.313	0.343	Color Coordinates	*2)
		y		0.299	0.329	0.359		
	Red	x		(0.625)	(0.655)	(0.685)		
		y		(0.299)	(0.329)	(0.359)		
	Green	x		(0.246)	(0.276)	(0.306)		
		y		(0.587)	(0.617)	(0.647)		
	Blue	x		(0.114)	(0.144)	(0.174)		
		y		(0.058)	(0.088)	(0.118)		
Gamut		CG	θ=ψ= 0°		100		%	
Gamma		γ	VESA	2.0	2.2	2.4	--	*6)

[Note]

Color coordinate and color gamut are measured by CS-1000, and all the other items are measured by BM-5A(TOPCON). All these items are measured under the dark room condition (no ambient light).

Measurement Condition: IL=7.0mA × 4

Inverter: Sumida, model: IV50167/T－－ , Frequency=50kHz.

Definition of these measurement items is as follows:

1) Definition of Contrast Ratio

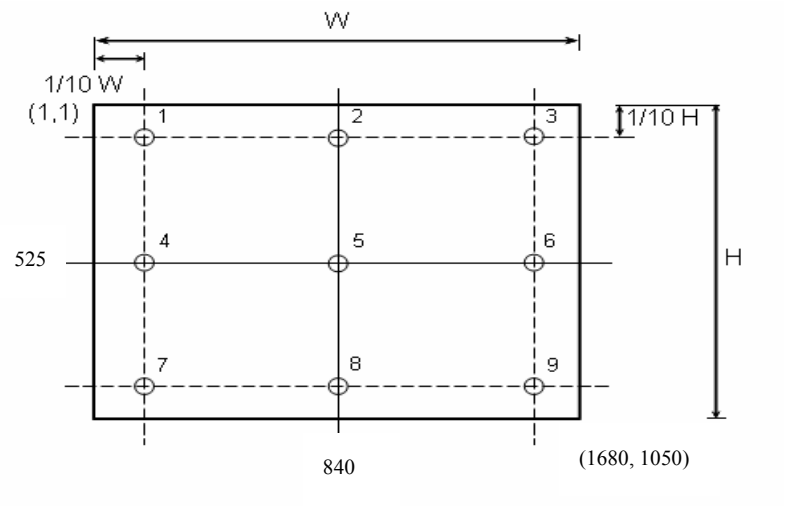
CR=ON (White) Luminance/OFF (Black) Luminance

2) Definition of Luminance and Luminance uniformity

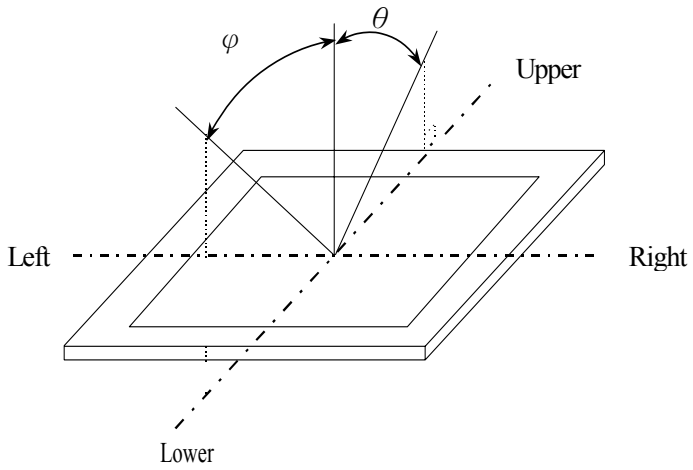
Central luminance: The white luminance is measured at the center position “5” on the screen, see Fig.1 below. And the measure time is 30 min after discharged.

9P Luminance (AVG): The white luminance is measured at measuring points 1 to 9, see Fig.1 below.

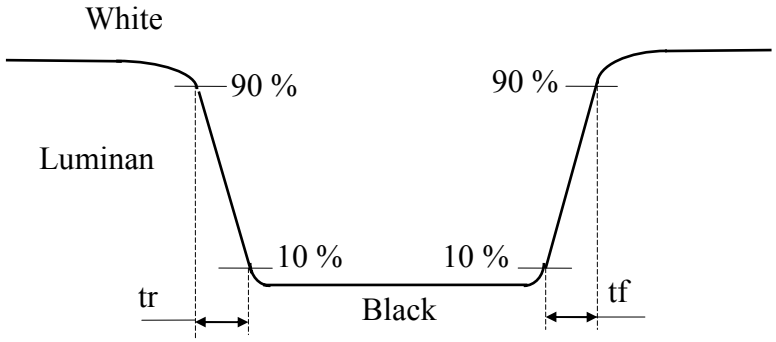
9P Uniformity: $\Delta L = (L_{MIN} / L_{MAX}) \times 100\%$



3).Definition of Viewing Angle (θ,ψ):



4) Definition of Response Time:

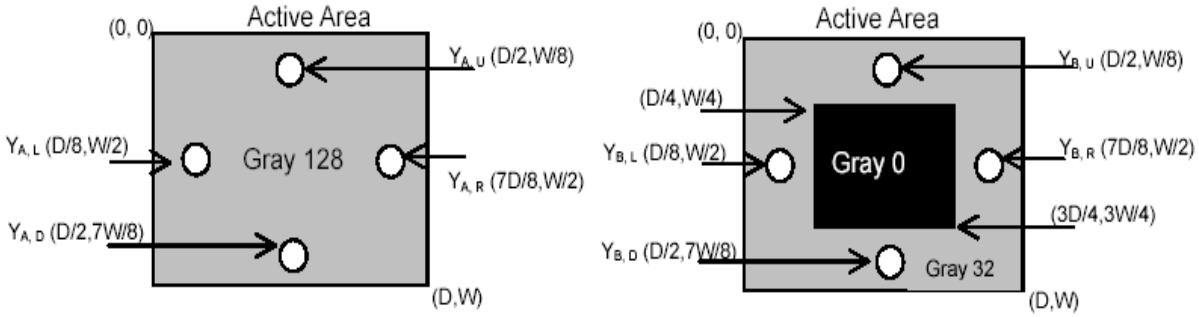


5) Definition of crosstalk:

$CT = | Y_B - Y_A | / Y_A \times 100\ (\%)$

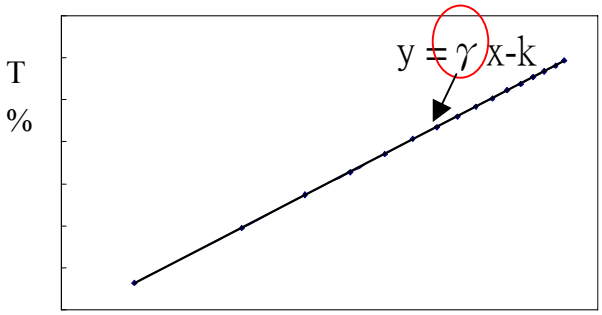
Y_A : The luminance of measured position at pattern A

Y_B : The luminance of measured position at pattern B with Gray level 0



Pattern A Pattern B

6) Definition of Gamma (γ), follow VESA standard sampling every 16 gray level(0,16,32,…..224,240,255)



Gray level(LOG)

9. RELIABILITY TEST CONDITIONS

(1) Temperature and Humidity

TEST ITEMS	CONDITIONS
HIGH TEMPERATURE HIGH HUMIDITY OPERATION	50℃; 90%RH; 240h (No condensation)
HIGH TEMPERATURE HIGH HUMIDITY STORAGE	60℃; 90%RH;48h (No condensation)
HIGH TEMPERATURE OPERATION	50℃; 240h
HIGH TEMPERATURE STORAGE	60℃; 240h
LOW TEMPERATURE OPERATION	0℃; 240h
LOW TEMPERATURE STORAGE	-20℃; 240h
THERMAL SHOCK	BETWEEN -20℃(1hr)AND 60℃(1hr); 100 CYCLES

(2) Shock & Vibration

ITEMS	CONDITIONS
SHOCK (NON-OPERATION)	Shock level:980m/s^2(100G) Waveform: half sinusoidal wave, 2ms Number of shocks: one shock input in each direction of three mutually perpendicular axes for a total of six shock inputs
VIBRATION (NON-OPERATION)	Vibration level: 9.8m/s^2(1.0G) zero to peak Waveform: sinusoidal Frequency range: 5 to 500 Hz Frequency sweep rate: 0.5 octave/min Duration: one sweep from 5 to 500Hz in each of three mutually perpendicular axis(each x,y,z axis: 1 hour, total 3 hours)

(3) ESD

POSITION	CONDITION(MDL turn off)
Connector	1. 200 pF，0 Ω，±250 V 2. contact mode for each pin
Module	1. 150 pF，330 Ω，±15K V 2. Air mode, test 25 times for each test point 3. Contact mode, 25 times for each test point

(4) Low Pressure test

TEST ITEM	CONDITION
Low Pressure test(storage)	260HPa (30000 ft.)；24 Hr

(5) Judgment standard

The judgment of the above test should be made as follow:

Pass: Normal display image with no obvious non-uniformity and no line defect. Partial transformation of the module parts should be ignored.

Fail: No display image, obvious non-uniformity, or line defects.